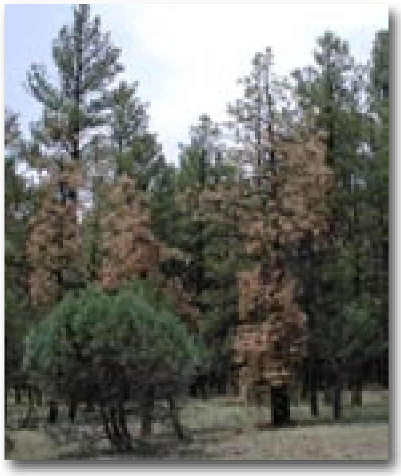
Seventh Grade

Effects of Fire on the Diversity of the Forest



Introduction

Good morning/afternoon. I am _______________, and I work for the ___________ National Forest. My job is ______ _________________.

Lesson

Who thinks they know the worst fire in United States history? (Give students a chance to offer some ideas. Many may say the Rodeo-Chediski Fire. The Rodeo-Chediski Fire was the largest – in terms of acres burned – of any fire ever in Arizona. It was not the "worst" fire ever in the U.S. in terms of acreage or lives lost.) A fire in Peshtigo, Wisconsin, (http://mt.essortment.com/peshtigofire_rixl.htm) in 1871 started in dry timber just outside of town. With terrifying force, the fire swept into town and killed 1,125 people. In terms of people killed, this was the worst fire in U.S. history – even worse than the great Chicago Fire that burned that same day, killing 250 people!

Those and other deadly fires convinced people that we had to do everything in our power to manage this awesome force of nature. And that is exactly what we set out to do – "manage" fire. How do you think we have done "managing" fire? Can we "manage" a force of nature like fire? (Give students a chance to express some of their viewpoints. There really are not right and wrong answers.)

Forest Service Messages

A-1: Fire has a natural role in the ecosystem.
A-5: The study of the science of fire and its behavior is important.
B-1: People need to be careful with fire.
B-3: Human development near or within forest boundaries has a long-lasting effect and brings risks and obligations.
B-4: The complexity of managing our public lands is compounded by the numbers of people living near or within our boundaries and the increasing demands from public land users.
C-1: Prior to European settlement, Southwestern ponderosa pine forests had far fewer trees than today and had frequent, low-intensity surface fires.
C-3: Forest conditions now are not natural or healthy.
C-4: Because of unnaturally dense conditions, our forests are at risk for destructive wildland fires, insect infestations and diseases.
C-5: In many places on Southwestern forests, conditions now are such that wildland fires can have devastating, long-lasting effects.
C-6: The Forest Service cuts trees to accomplish specific objectives within the ecosystem such as reducing the risk of wildland fire, enhancing dwindling aspen stands, restoring grasslands, and improving forest health and wildlife habitat.
C-7: The Forest Service manages for biodiversity, not single species.
C-8: Doing nothing is not always the right answer. The Forest Service alone cannot know the right answer, but by collaborating with the public, we can come closer to it.
C-9: Prescribed fire is one tool the Forest Service uses to meet ecosystem goals.

Academic Standards

Arizona Standards

SCIENCE

3SC-E3: Identify a specific need and propose a solution or product that addresses this need, taking into consideration various factors
PO 1: Design a solution or product that addresses a need and considers the factors of an environmental or human problem

An engine crew is monitoring an underburn, in which fire is used to burn off the natural litter layer that has accumulated on the forest floor.

Now, we are going to view a slideshow on fire in the forest. (Show slideshow.)

Fire in the Forest PowerPoint Presentation (This slideshow can be adapted to fit any forest in the Southwest Region.)

Slide 1
Fires are a usual occurrence on the Kaibab National Forest – as expected as the sun rising and setting.

Slide 2
It is not uncommon for us to have 200 or more fires each year. The majority of these fires are caused by lightning – usually preceding or during the monsoons. While we do get human-caused starts, they are not as frequent on the Kaibab as they are on our neighboring forests – the Coconino and the Prescott, which are headquartered in more urban areas – Flagstaff and Prescott respectively.

The vast majority of the fires we have remain small – many just a tenth of an acre or less. Here's a typical scenario – it's late July; a storm cell moves through producing precipitation and lightning. A lightning bolt strikes a tree. A small fire begins near the lightning strike and sort of smolders for awhile. By the hottest part of the next day, the fire produces enough smoke for it to be sighted by one of our lookouts. We send out resources, and the fire is quickly contained. That happens on a very regular basis. However, when conditions are extremely dry as they have been in recent years, the situation can become much different.

4SC-E7: Explain and model the interaction and interdependence of living and non-living components within ecosystems, including the adaptation of plants and animals to their environment
PO 1: Explain the role of living/non-living components in an ecosystem
PO 2: Create a model of the interaction of living/non-living components within an ecosystem
6SC-E4: Provide evidence of how life and environmental conditions have changed
PO 1: Compare and contrast the life and environmental conditions within geological time periods
3SC-E1: Recognize how scientific knowledge, thinking processes and skills are used in a great variety of careers
PO 1: Explain how scientific knowledge, thinking processes and skills are used to solve problems in a variety of careers
4SC-P6: Describe and explain how the environment can affect the number of species and the diversity of species in an environment
PO 3: Predict how a change in an environmental factor can affect the number of organisms in a population
PO 4: Predict how a change in an environmental factor can affect the biodiversity in an ecosystem
1SC-E3: Organize and present data gathered from their own experiences, using appropriate mathematical analyses and graphical representations
PO 1: Construct a representation of data (e.g., histogram, stem-and-leaf plot, scatter plot, circle graph, flow chart)
PO 2: Interpret patterns in collected data

SOCIAL STUDIES
3SS-E2: Describe the impact of interactions between people and the natural environment on the development of places and regions in Arizona, including how people have adapted to and modified the environment, with emphasis on:
PO 4: how people have depended on the physical environment and its natural resources to satisfy their basic needs, including the consequences of Arizonans' adaptation to, and modification of, the natural environment
3SS-E7: Explain the effects of interactions between human and natural systems, including the changes in the meaning, use, and distribution of natural resources, with emphasis on:
PO 2: consequences to humans of earthquakes, hurricanes, tornadoes, flash floods, and other natural hazards
PO 3: how and why humans modify ecosystems, including deforestation and desertification
PO 4: how changes in the natural environment can increase or diminish its capacity to support human activities

When fires move through an area, they often leave some trees and bushes untouched. Fires often leave a mosaic pattern – with areas that were severely, moderately and lightly burned and some areas that were not burned at all. In this photo, you can see both burned and unburned areas.

Slide 3
I want to emphasize that fire is a very natural part of the Southwestern ponderosa pine ecosystem. Fire has been a part of this forest since long before we were here. In many ways, fire is a healthy, vital part of the forest. It recycles nutrients back into the soil and cleans up the forest by removing accumulations of pine needles, duff and other forest debris. After a fire moves through an area, you will often see how quickly green grasses sprout up, providing nourishment for forest animals.

Slide 4
But we have also all seen – especially in recent years – how dangerous, destructive and devastating wildfires can be. They can literally devour hundreds of thousands of acres of forest. They can destroy communities. They can threaten lives. They can leave people without homes. Arizona experienced its largest wildfire ever in 2002. At more than 400,000 acres, the Rodeo-Chediski Fire seared an image of wildfires into people's minds that they won't soon be able to modify.

So, why are we seeing such monstrous, devastating wildfires if they are supposed to be a natural, healthy, positive part of our forests? The reason is simply this – fire has changed. What I mean by that is that the kind of wildfires we are seeing now are different than the kind of wildfires that moved through this area more than a century ago. Why? Fires have changed because the forest has changed.

Slide 5
Prior to European settlement in this area, low-to-medium intensity ground fires moved through our forests every 2-10

MATH

2M-E1: Construct, read, analyze and interpret tables, charts, graphs and data plots (e.g., box-and-whisker, stem-and-leaf, and scatter plots)
PO 3: Choose an appropriate graphical format to organize and represent data
2M-E2: Make valid inferences, predictions and arguments based on statistical analysis
PO 1: Formulate predictions from a given set of data and justify predictions
PO 2: Compare a given prediction with the results of an investigation
2M-E3: Display and use measures of range and central tendency (i.e., mean, median and mode)
PO 2: Find the mean, median, mode and range of a data set
PO 3: Choose appropriate measures of central tendencies to describe given or derived data
3M-E4: Analyze functional relationships to explain how a change in one variable results in a change in another
PO 2: Produce the rule (function) that explains the relationship (pattern) between the numbers when a change in the first variable affects the second variable (T-chart, two-row table, or input/output machine)
PO 4: Complete a T-chart for a given rule
3M-E8: Develop, analyze and explain methods for solving proportions
PO 1: Describe how to solve a problem in context using a proportion
PO 2: Compare quantities using ratios
PO 3: Solve proportions using formal (e.g., cross product) or informal methods (e.g., diagrams, geometric models)

New Mexico Standards

SCIENCE

Strand I: Scientific Thinking and Practice

Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.
5-8 Benchmark I: Use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.
Grade 7 Performance Standards
1. Use a variety of print and web resources to collect information, inform investigations, and answer a scientific question or hypothesis.
2. Use models to explain the relationships between variables being investigated.

years, killing many small trees but sparing the larger ones. Ponderosa pines, which are adapted to that kind of fire regime, develop thick bark as they age, which helps protect them from frequent ground fires. The forest, as described by early settlers, was open and parklike with significant spacing between trees.

Around 1870, things began to change. Heavy, unregulated grazing lasting several decades reduced the grass cover that carried ground fires. Those fires that did get started were quickly suppressed. Fire exclusion, livestock grazing and other factors have created forests much more dense than they were a century and more ago.

In order to try to prevent high-intensity wildland fires, land managers often intentionally light fires on days when the fires are likely to remain at low-to-moderate levels of intensity. These photos show two different kinds of burns on the Kaibab National Forest in northern Arizona. In one photo, tree slash that was left over from a thinning project has been piled and is being burned.

Slide 6

Natural wildland fires moving through a relatively open landscape with large trees like we see here in 1910 would have, for the most part, remained on the ground. Many smaller trees would have been killed by the flames, but most of the larger ones would have remained.

Slide 7

By the 1930s after settlers had established themselves in the area, you can see a large crop of small trees growing unimpeded in the forest. Because the grasses that carried fires were being eaten by livestock and the fires that did get started were quickly put out, the small trees had no barriers to continued growth. In basic terms, the natural ways – such as frequent low-to-medium intensity ground fires – that Mother Nature had used to regulate tree density had been taken away.

Slide 8

By 1989, the forest is crowded with dense thickets of trees. If a wildland fire were to move through this area, the outcome would be much different than it was in 1910. The small trees

5-8 Benchmark III: Use mathematical ideas, tools, and techniques to understand scientific knowledge.

Grade 7 Performance Standards

1. Understand that the number of data (sample size) influences the reliability of a prediction.
2. Use mathematical expressions to represent data and observations collected in scientific investigations.
3. Select and use an appropriate model to examine a phenomenon.

Strand II: Content of Science

Standard I (Physical Science): Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

5-8 Benchmark II: Explain the physical processes involved in the transfer, change, and conservation of energy.

Grade 7 Performance Standards

1. Know how various forms of energy are transformed through organisms and ecosystems, including:
   - sunlight and photosynthesis
   - energy transformation in living systems (e.g., cellular processes changing chemical energy to heat and motion)
   - effect of mankind's use of energy and other activities on living systems (e.g., global warming, water quality).

Strand II: Content of Science

Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

5-8 Benchmark I: Explain the diverse structures and functions of living things and the complex relationships between living things and their environments.

Grade 7 Performance Standards

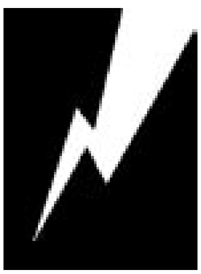
Populations and Ecosystems

1. Identify the living and nonliving parts of an ecosystem and describe the relationships among these components.
2. Explain biomes (i.e., aquatic, desert, rainforest, grasslands, tundra) and describe the New Mexico biome.
3. Explain how individuals of species that exist together interact with their environment to create an ecosystem (e.g., populations, communities, niches, habitats, food webs).
4. Explain the conditions and resources needed to sustain life in specific ecosystems.
5. Describe how the availability of resources and physical factors limit growth (e.g., quantity of light and water, range of temperature, composition of soil) and how the water, carbon,

would form a ladder, carrying the flames into the tops of trees. The flames would quickly spread across the treetops, probably killing most trees in its path. A fire in this forest could result in destruction of the entire area.

Slide 9
Fire isn't the only thing that has changed over the years. People have also changed. More and more families are choosing – and I emphasize the word choosing – to move into what we call the wildland-urban interface, the areas where our forests and communities meet. Along with the beauty of the trees and wildlife comes the threat of wildland fire.

Slide 10
With the changing dynamics of fire and where people are choosing to live, what is our role – as land management agency employees – in preventing destructive fires in the wildland-urban interface? We actually have many roles.



I can sum it up quickly – prevention, suppression and fuels management. Prevention is truly the cornerstone of any fire management program. We want to work to stop fires before they start. While we can't prevent lightning strikes, we can work to reduce the number of human-caused fires. With less human-caused fires to fight, we will have more firefighting resources available to attack the inevitable lightning-caused blazes.

Slide 11
The second major role of the Forest Service in today's fires is suppression.

Slide 12
Lookouts are stationed at strategic locations across the forest. Lookouts are often the first people to report a smoke sighting. All smoke reports eventually make their way to our Dispatch office. Dispatch is responsible for assigning resources to the fire and keeping track of all units responding.

and nitrogen cycles contribute to the availability of those resources to support living systems.

Biodiversity

6. Understand how diverse species fill all niches in an ecosystem.
7. Know how to classify organisms: domain, kingdom, phylum, class, order, family, genus, species.

Strand II: Content of Science

Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

5-8 Benchmark II: Describe the structure of Earth and its atmosphere and explain how energy, matter, and forces shape Earth's systems.

Grade 7 Performance Standards

1. Understand how the remains of living things give us information about the history of Earth, including:
   - layers of sedimentary rock, the fossil record, and radioactive dating showing that life has been present on Earth for more than 3.5 billion years.
2. Understand how living organisms have played many roles in changes of Earth's systems through time (e.g., atmospheric composition, creation of soil, impact on Earth's surface).
3. Know that changes to ecosystems sometimes decrease the capacity of the environment to support some life forms and are difficult and/or costly to remediate.

SOCIAL STUDIES

Strand: History

Content Standard I: Students are able to identify important people and events in order to analyze significant patterns, relationships, themes, ideas, beliefs, and turning points in New Mexico, United States, and world history in order to understand the complexity of the human experience.

5-8 Benchmark I-D (Skills): Research historical events and people from a variety of perspectives.

Grade 7 Performance Standards

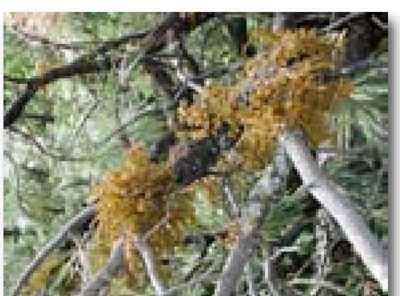
1. Analyze and evaluate information by developing and applying criteria for selecting appropriate information and use it to answer critical questions.
2. Demonstrate the ability to examine history from the perspectives of the participants.
3. Use the problem-solving process to identify a problem; gather information, list and consider advantages and disadvantages, choose and implement a solution, and evaluate the

Slide 13
Often, the first resources to be assigned to an incident and arrive on scene are our ground resources, which include engines, patrol units and dozers.

Slide 14
Other tools in the arsenal are aerial resources. Helicopters have various roles in a wildland fire situation. First, they can perform aerial reconnaissance missions to provide information on the location, size and behavior of a wildland fire. Second, they can quickly deliver firefighters to remote locations where they can begin initial attack operations. In terrain too rough for the helicopter to land, firefighters use rappel operations to get from air to ground quickly. The third and probably most well-known function of helicopters is to drop water onto wildland fires. Finally, helicopters also deliver cargo to firefighters and support personnel on the ground.

Slide 15
On to the third and final role of the Forest Service in today's fires – Fuels Management. I'm going to cover what that is, why it's important and the current fuels management initiatives in place on the Kaibab National Forest.

Slide 16
So, what do I mean by Fuels Management? Fuels Management most basically involves evaluating the current conditions of dead and live fuels – for instance, pine needles, trees, snags, debris on the forest floor – and determining the best tools to manage those fuels. Two of our most common Fuels Management tools are tree thinning, in which we remove trees from overstocked stands, and prescribed burning, in which forest managers intentionally start fires. Both tools, when used correctly,



The forests in the Southwest are unhealthy. There are too many trees and not enough water to sustain them all. The trees are becoming more and more susceptible to insect infestation, disease, and high-intensity wildland fire.

effectiveness of the solution using technology to present findings.

Strand: Geography

Content Standard II: Students understand how physical, natural, and cultural processes influence where people live, the ways in which people live, and how societies interact with one another and their environments.

5-8 Benchmark II-D: Explain how physical processes shape the Earth's surface patterns and biosystems.

Grade 7 Performance Standards

1. Explain how physical processes influence the formation and location of resources.
2. Use data to interpret changing patterns of air, land, water, plants, and animals.
3. Explain how ecosystems influence settlements and societies.

MATH

Strand: Algebra

Standard: Students will understand algebraic concepts and applications.

5-8 Benchmark: Understand patterns, relations, and functions.

Grade 7 Performance Standards

1. Identify and continue patterns presented in a variety of formats.
2. Represent a variety of relationships using tables, graphs, verbal rules, and possible symbolic notation, and recognize the same general pattern presented in different representations.
3. Simplify numerical expressions by applying properties of rational numbers, and justify the process used.
4. Interpret and evaluate expressions involving integer powers and simple roots.
5. Graph and interpret linear functions.
6. Solve problems involving rate, average speed, distance, and time.

Strand: Data Analysis and Probability

Standard: Students will understand how to formulate questions, analyze data, and determine probabilities.

5-8 Benchmark: Select and use appropriate statistical methods to analyze data.

Grade 7 Performance Standards

1. Choose and justify appropriate measures of central tendencies (e.g., mean, median, mode, range) to describe given or derived data.
2. Know various ways to display data sets (e.g., stem and leaf plot, box and whisker plot, scatter plots) and use these forms to display a single set of data or to compare two sets of data.

can improve overall forest health. Fuels Management can be much more than just thinning and prescribed burning, though. For the average homeowner, Fuels Management can mean thinning and pruning trees, mowing grass and removing brush, moving wood piles away from homes, and cleaning debris from rain gutters.

As part of wildland fire suppression efforts, helicopter crewmembers can rappel into areas that are difficult to access by road and begin firefighting operations. Firefighters must go through extensive training before being allowed to participate in rappel operations.

Slide 17
So, why do we even need Fuels Management? Shouldn't we just leave the forest and trees the way they are? Think back to my earlier description of how the forests have changed over the last century and the resulting changes in the kind of wildfires we are seeing. Given the history of our forests, there are several reasons why Fuels Management is important. The one that most people are now coming to realize is wildland fire risk reduction. The overarching goal of many Fuels Management projects is to reduce the threat of wildland fire. Thinning and burning treatments help remove the materials that fuel fires.

Slide 18
Through lessening the risk of wildland fire, Fuels Management projects help to protect lives and communities – especially in the areas where communities and forests meet, what we call the wildland-urban interface.

Slide 19
Fuels Management projects improve the overall forest health in the areas treated. For example, thinning improves the rate of growth in the remaining stand and makes the trees that are left healthier. Also important in these drought years is the fact that dense tree stands require more moisture, and drought-stressed

3. Use the analysis of data to make convincing arguments.

Strand: Data Analysis and Probability

Standard: Students will understand how to formulate questions, analyze data, and determine probabilities.

5-8 Benchmark: Develop and evaluate inferences and predictions that are based on data.

Grade 7 Performance Standards

1. Formulate and justify mathematical conjectures based on data and a general description of the mathematical question or problem posed.
2. Analyze data to make accurate inferences, predictions, and to develop convincing arguments from data displayed in a variety of forms.

trees are more vulnerable to insect infestation and disease. We have seen this clearly over the last few years. Our forests are filled with dead and dying trees – from drought, dwarf mistletoe, and bark beetle infestation.

Slide 20
Finally, Fuels Management projects can help to get our forests closer to historic ecological conditions – open, parklike and with abundant grasses and forbs.

Slide 21
Thank you for your time. I hope that you leave today with a better understanding of fire in our forest. It is really important that we all have some background knowledge about fire's role in our forest, the fire history of our forest, and the role the Forest Service plays in today's fires.

(End slideshow.)

Activity

Now I want to ask you a question based on everything you have learned about fire in our forest. Do you think fire increases or decreases diversity within a forest? (Let the students have time to comment.) As our activity for today, we are going to study some research that will prove the answer to that question – one way or the other.

I am going to ask you to graph information collected before and after treatment with thinning and prescribed burning on two different research plots. This is real research that was shared with us by Mark Daniels at Northern Arizona University in Flagstaff, Arizona. The data come from two plots at a study site near Mount Trumbull on the Arizona Strip. The plots were measured before treatments in 1996 and then again in 1999 after treatments of thinning and prescribed burning.

Spreadsheet #1 "Species Lists" shows the number of species both pre- and post-treatment with thinning and prescribed burning for Plots A and B.

Spreadsheet #2 "Frequencies" shows the actual frequency measurements of individual plant species both pre- and post-treatment with thinning and prescribed burning for Plots A and B.

Forest Service Conservation Education Learner Guidelines

Program title: The Effects of Fire on the Diversity of the Forest
Target audience: Seventh Grade
Primary topic: Fuels management helps increase diversity in the forest.

Length of program: 1 to 1.25 hours

Setting: indoors

Guidelines addressed are referenced here:

5-8
I. Questioning and Analysis Skills
A1, A2, B2, C2, C3, E1, E3, G2,
G3
II. Knowledge of Environmental Processes and Systems
1. A1, A2, C2
2. A1, C2, C3, C4, D1
3. B2, C1, C3
4. A1, A2, A3, C4, D1, D2
III. Skills for Understanding and Addressing Environmental Issues
1. A1, A3, B1, B2, B3, C2, D1
2. A1, A2, B1, D1
IV. Personal and Civic Responsibility
A3, B2, B3, C1, C2

Do you think there will be a greater number of species present in each plot before or after thinning and burning?

Do you think there will be higher or lower numbers of plants within each species after thinning and burning?

Let's find out!

(Break students into five groups.)

(All groups are to use line graphs or bar charts.)

Group 1: Graph number of species pre- and post-treatments for Plots A and B.
(Presenter/Teacher Tip: Use a line graph or bar chart. Prior to treatment, Plot A has 8 species present. Post-treatment, Plot A has 34 species present. Prior to treatment, Plot B has 11 species present. Post-treatment, Plot B has 33 species present.)

Groups 2 and 4: Graph percentage of each species pre- and post-treatment for Plot A. Please notice that there are more species post-treatment in Plot A. You only need to graph the changes for those species that were present pre-treatment. (If there is extra time for graphing, students can use zero as the pre-treatment frequency for all those species that manifested post-treatment in Plot A.)

Groups 3 and 5: Graph percentage of each species pre- and post- for Plot B. Please notice that there are more species post-treatment in Plot B. You only need to graph the changes for those species that were present pre-treatment. (If there is extra time for graphing, students can use zero as the pre-treatment frequency for all those species that manifested post-treatment in Plot B.)

(Have a representative from each group share their findings with the class. If there is time, you may want to re-create some of their graphs/charts on the board.)

So, was there a greater number of species present in each plot before or after thinning and burning? (After!)

So, were there higher or lower numbers of plants within each species after thinning and burning? (Higher!)

Closing

I hope that from the presentation and activity, you learned that keeping fire out of the forest is not a good idea and really is not possible. Fire plays a natural role in our forest. In fact, it is essential to forest health.

Handout

Forest Service brochures on fire (any or all of the following):

- "Fire and the Changing Land"
- "Rx Fire!"
- "Living With Fire"

Set of Smokey Posters on Diversity for the classroom

Supplies

- Laptop
- Projector
- Screen
- "Fire In Our Forest" PowerPoint (see companion PowerPoint presentation.)
- Pencils (one per student)
- Graph paper (a few sheets per group – five groups)
- Hard copies of "Seventh Grade Data" spreadsheet (one copy per group – five groups)
- Forest Service brochures on fire
- Set of Smokey Posters on Diversity (one per classroom)
  - Available through National Symbols Catalog.
  - Collated sets of 15 posters (6 complete sets of 15). Reserve a special place on the wall for these colorful posters as a bright reminder to Smokey Bear's partners in fire prevention. Set includes: trees, birds, mammals, invertebrates, nests, tracks, butterflies, wildflowers, insects, fish, snakes, mushrooms, herbs, and leaf types along with "Don't Light Up the Night".

Student Page

Seventh Grade Data Spreadsheets

Species lists from two plots, both pre-treatment and 3 years after thinning & burning:

Plot#	Trt Status	Common Name	Date
A	PRE	beardlip penstemon	4/10/1996
A	PRE	big sagebrush	4/10/1996
A	PRE	Carruth's sagewort	4/10/1996
A	PRE	common dandelion	4/10/1996
A	PRE	New Mexico locust	4/10/1996
A	PRE	silver lupine	4/10/1996
A	PRE	thick-leaf beardtongue	4/10/1996
A	PRE	western bottle-brush grass	4/10/1996
A	POST	American dragonhead	5/31/1999
A	POST	beardlip penstemon	5/31/1999
A	POST	big sagebrush	5/31/1999
A	POST	birdsfoot trefoil	5/31/1999
A	POST	blue grama	5/31/1999
A	POST	Canadian horseweed	5/31/1999
A	POST	cheatgrass	5/31/1999
A	POST	common mullein	5/31/1999
A	POST	coyote tobacco	5/31/1999
A	POST	desert ragwort	5/31/1999
A	POST	Douglas' knotweed	5/31/1999
A	POST	Fendler's rockcress	5/31/1999
A	POST	Gambel oak	5/31/1999
A	POST	hoary aster	5/31/1999
A	POST	horned spurge	5/31/1999
A	POST	lambsquarters	5/31/1999
A	POST	lobeleaf groundsel	5/31/1999
A	POST	longleaf phlox	5/31/1999
A	POST	New Mexico bird's-foot trefoil	5/31/1999
A	POST	New Mexico locust	5/31/1999
A	POST	nodding buckwheat	5/31/1999
A	POST	pale agoseris	5/31/1999
A	POST	ponderosa pine	5/31/1999
A	POST	red monkeyflower	5/31/1999
A	POST	silver lupine	5/31/1999
A	POST	slender phlox	5/31/1999
A	POST	smallflower blue eyed Mary	5/31/1999
A	POST	spreading groundsmoke	5/31/1999
A	POST	stickywilly	5/31/1999
A	POST	tall annual willowherb	5/31/1999
A	POST	thick-leaf beardtongue	5/31/1999
A	POST	wax currant	5/31/1999
A	POST	western bottle-brush grass	5/31/1999
A	POST	wheatgrass	5/31/1999

B	PRE	big sagebrush	4/10/1996
B	PRE	cheatgrass	4/10/1996
B	PRE	common mullein	4/10/1996
B	PRE	desert ragwort	4/10/1996
B	PRE	hoary aster	4/10/1996
B	PRE	horned spurge	4/10/1996
B	PRE	lobeleaf groundsel	4/10/1996
B	PRE	pale agoseris	4/10/1996
B	PRE	silver lupine	4/10/1996
B	PRE	wax currant	4/10/1996
B	PRE	western bottle-brush grass	4/10/1996
B	POST	beardlip penstemon	5/31/1999
B	POST	big sagebrush	5/31/1999
B	POST	Canadian horseweed	5/31/1999
B	POST	Carruth's sagewort	5/31/1999
B	POST	cheatgrass	5/31/1999
B	POST	common mullein	5/31/1999
B	POST	common pepperweed	5/31/1999
B	POST	cryptantha	5/31/1999
B	POST	desert ragwort	5/31/1999
B	POST	Douglas' knotweed	5/31/1999
B	POST	Fendler's rockcress	5/31/1999
B	POST	Gambel oak	5/31/1999
B	POST	hoary aster	5/31/1999
B	POST	horned spurge	5/31/1999
B	POST	lambsquarters	5/31/1999
B	POST	lobeleaf groundsel	5/31/1999
B	POST	New Mexico locust	5/31/1999
B	POST	nodding buckwheat	5/31/1999
B	POST	prickly lettuce	5/31/1999
B	POST	red monkeyflower	5/31/1999
B	POST	showy goldeneye	5/31/1999
B	POST	silver lupine	5/31/1999
B	POST	slender phlox	5/31/1999
B	POST	smallflower blue eyed Mary	5/31/1999
B	POST	spotted missionbells	5/31/1999
B	POST	spreading fleabane	5/31/1999
B	POST	spreading groundsmoke	5/31/1999
B	POST	spreading sandwort	5/31/1999
B	POST	tall annual willowherb	5/31/1999
B	POST	toadflax penstemon	5/31/1999
B	POST	western bottle-brush grass	5/31/1999
B	POST	Wright's deervetch	5/31/1999
B	POST	yellow salsify	5/31/1999

Student Page

Plant species' frequencies from two plots, both pre-treatment and 3 years after thinning & burning:

Plot#	Trt Status	Species/Substrate	Frequency (%)	Date
A	PRE	big sagebrush	1.81	4/10/1996
A	PRE	western bottle-brush grass	1.51	4/10/1996
A	PRE	silvery lupine	1.20	4/10/1996
A	PRE	thick-leaf beardtongue	0.60	4/10/1996
A	PRE	New Mexico locust	0.30	4/10/1996
A	PRE	common dandelion	0.30	4/10/1996
A	POST	silvery lupine	9.94	5/31/1999
A	POST	New Mexico locust	3.31	5/31/1999
A	POST	cheatgrass	3.01	5/31/1999
A	POST	smallflower blue eyed Mary	2.71	5/31/1999
A	POST	western bottle-brush grass	2.71	5/31/1999
A	POST	big sagebrush	2.11	5/31/1999
A	POST	lobeleaf groundsel	1.20	5/31/1999
A	POST	thick-leaf beardtongue	1.20	5/31/1999
A	POST	Gambel oak	0.90	5/31/1999
A	POST	slender phlox	0.60	5/31/1999
A	POST	common mullein	0.60	5/31/1999
A	POST	spreading groundsmoke	0.60	5/31/1999
A	POST	New Mexico bird's-foot trefoil	0.30	5/31/1999
A	POST	wheatgrass	0.30	5/31/1999
A	POST	blue grama	0.30	5/31/1999
B	PRE	big sagebrush	2.41	4/10/1996
B	PRE	western bottle-brush grass	1.81	4/10/1996
B	PRE	cheatgrass	1.20	4/10/1996
B	PRE	common mullein	0.30	4/10/1996
B	POST	big sagebrush	4.22	5/31/1999
B	POST	smallflower blue eyed Mary	4.22	5/31/1999
B	POST	silvery lupine	3.61	5/31/1999
B	POST	western bottle-brush grass	3.01	5/31/1999
B	POST	cheatgrass	2.71	5/31/1999
B	POST	New Mexico locust	2.41	5/31/1999
B	POST	lobeleaf groundsel	2.11	5/31/1999
B	POST	Canadian horseweed	1.81	5/31/1999
B	POST	common mullein	1.81	5/31/1999
B	POST	tall annual willowherb	0.90	5/31/1999
B	POST	desert ragwort	0.60	5/31/1999
B	POST	slender phlox	0.60	5/31/1999
B	POST	Gambel oak	0.30	5/31/1999
B	POST	red monkeyflower	0.30	5/31/1999
B	POST	horned spurge	0.30	5/31/1999
B	POST	lambsquarters	0.30	5/31/1999
B	POST	prickly lettuce	0.30	5/31/1999